

> **ADVANCING EOR: MATURITY-DRIVEN TRL APPROACH**

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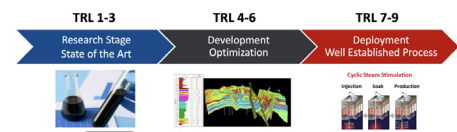
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The foundation of Technology Readiness Levels (TRL) originated with NASA in the United States, shaping the classification that reflects a technology's state of development concerning broad production and application. The assessment of TRL and its assignment serves as a compass, indicating the readiness of a process or technology for wide market implementation. This knowledge empowers developers and stakeholders to monitor research progress and select technologies primed for full-scale deployment. In the context of EOR projects within the petroleum industry, this methodology offers a nine-tier spectrum of technology availability. Levels 1-3 signify the "Research" stage, 4-6 indicate "Development," and 7-9 represent "Deployment."

EOR Technology Assessment: Marrying Technical and Economic Realities

The rigorous evaluation of Enhanced Oil Recovery (EOR) technologies necessitates a comprehensive consideration of technical-economic factors. This comprises Laboratory Experiments, Reservoir Modelling, Advanced Screening Processes, Sensitivities, and Production Forecasts. The optimization and hierarchy of scenarios play a critical role in selecting the most viable options before proceeding to implementation. Amidst this intricate landscape, the maturity degree of EOR technology emerges as a linchpin for risk mitigation and project success. Embedding the TRL approach into the EOR technology selection process offers a roadmap to enhance the probability of success, both in pilot and full-scale ventures. Within the TRL paradigm, EOR processes find their footing within the distinguished category No.9. Here, Polymer Flooding, Miscible Gas Process, Steam Flooding, and Cyclic Steam Stimulation (CSS) stand as stalwarts of established EOR methodologies across the globe. These techniques have withstood the test of technical and economic scrutiny through numerous projects, attaining the coveted status of technical-economic provenness. Of note, steam flooding reigns as the preeminent technique for optimizing hydrocarbon recovery in heavy oil reservoirs. However, a nuanced operator experience might call for updates to this referential matrix, enhancing the adaptability of EOR strategies to dynamic operational realities. In the relentless pursuit of increased oil production, it is imperative to remain vigilant against the influx of emerging technologies in the petroleum industry. These technologies, while promising, require careful evaluation within the framework of the well-established TRL approach. The realm of Enhanced Oil Recovery stands at the crossroads of technical prowess and economic feasibility. Through the lens of Technology Readiness Levels, the journey of technological advancement is illuminated, guiding the petroleum industry toward innovation while ensuring the integration of tried-and-true methodologies.



PHASE	TRL	EOR TECHNOLOGY
Research Stage	1 - 3	<ul style="list-style-type: none"> • Colloidal Dispersion Gels (CDG) Injection • Performed Particle Gels (PPG) • In situ upgrading • Delayed Action Polymer (DAP) Injection • Hybrid Process
Development - Optimization	4 - 6	<ul style="list-style-type: none"> • High Pressure Air Injection (HPAI) • Low Salinity Waterflooding • Water Alternate Gas Injection • Microbial • Polymer Disperse Systems (PDS) • Alkaline - Surfactant - Polymer (ASP) • SAGD
Well Established EOR Processes	7 - 9	<ul style="list-style-type: none"> • Polymer Flooding • Cyclic Steam Stimulation (CSS) • Miscible Gas Processes (CO2) • Steam Flooding